PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Vibration Damper for the Blades of Elastic Fluid Turbines, Compressors and the like

We, AKTIENGESELLSCHAFT BROWN, BOVERI & CIE., of Baden, Switzerland, a Swiss Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In order to damp the vibrations occurring in the moving blades of elastic fluid turbines it is known to arrange wires in holes provided in the blades, these wires being either soldered to the blades or so arranged in the holes that they are pressed against the wall of the hole by centrifugal force. In the case of the stationary blades in the casing where there is no centrifugal effect, the wires are either fixed by soldering or a number of wires made of flexible material are arranged in the hole in such a manner that they fit tightly into the holes in a flexible manner.

It is also known to connect or mutually support the blades by means of forged on, riveted or welded elements, in such a manner that dangerous bending oscillations are avoided, these elements generally forming a closed ring.

Experience shows, however, that all known damping means can prevent the occurrence of undesirable bending vibrations, but with certain flow velocities of the driving medium torsional vibrations which occur in the blades are not or are only inadequately damped.

The present invention consists in a vibration damper for the blades of elastic fluid turbines, compressors and the like, characterised by distance pins arranged approximately perpendicularly to the blade chords between all the blades of a blade row, the pins being fixed at one end only to a blade whilst at the other end they abut freely against pins fixed to the next blades or directly against the next blades, in the vicinity of at least one edge in order to damp torsional vibrations of the blades.

The invention also consists in vibration dampers substantially as herein described with reference to the accompanying diagrammatic drawings referred to below.

The accompanying diagrammatic drawings show some constructional examples of the invention:—

Figure 1 shows a number of slightly curved blades of a blade row in cross section, the distance pins according to the invention being shown in elevation;

Figure 2 shows a similar view of a number of highly curved blades and a modified form of distance piece;

Figure 3 shows a number of blades in lateral elevation which are protected against vibrations by distance pins in accordance with the invention and also in addition by means of the known type of binding or damping wires.

In Figure 1 blades 1 of the blade row shown are provided both in the vicinity of their inlet edge 2 as well as near their outlet edge 3 with a distance pin 4. These distance pins are so arranged that their axes 6 are approximately at right angles indicated at 7 to the chord 5 of the blades. The distance pins are fixed at one end to the blades, for instance by being machined integrally with the blade, or by being welded, screwed or riveted to the blade. At 8 the distance pin on the concave side abuts freely against the distance pin on the convex side of the neighbouring blade, so that each distance pin is at one end in free contact with one of the next blade. The distance pins may have a cross-section such as is indicated at 9, so that the resistance to the flow of the driving medium is reduced to a minimum.

In Figure 2 which illustrates a constructional form of the invention for blades having a profile with a greater curvature, it is shown that one end of the distance pin can be fixed to the individual blades in the vicinity of the central plane of the blade row, whilst the free ends of the distance pins 4 which extend over the width of the blade channels abut at 8 against the next blade, such contact being near the outlet edge 3 of the blades. In this case the axes 6 of the distance pins are again at least approximately at right angles (angle 7) to the blade chords 5.

In all cases it is important that the distance pins should not lie in the central plane of the blade row or in a plane parallel to this one and thus form a closed circle, but be inclined to the central plane due to them being

arranged perpendicular or approximately perpendicular to the blade chords, so that their axes form a zig-zag line with the blade chords. In this way each blade is controlled in the vicinity of at least one of its edges and prevented from turning.

As shown in Figure 3, the distance pins 4 are located in the middle third of the blade length. With long blades a binding or damping wire 10 can also be provided in the vicinity of the outer end of the blades. Together with these known means of preventing blade vibrations, the distance pins according to the invention also help to reduce the bending vibrations.

The distance pins according to the invention are intended particularly to damp the torsional vibrations which occur in the blades with certain flow velocities of the driving medium. If, as has already been proposed, such distance pins arranged inclined to the central plane of the blade row were to be fixed at both ends, for instance by riveting to the adjoining blades, they could not fulfil their task, because the blades would then so be joined together that if one blade turns counter-clockwise the next one would have to turn clockwise, and the one after this again counter-clockwise, and so on. This phase displacement of 180° from one to the next blade could not prevent the occurrence of torsional oscillations; on the contrary with such an arrangement there is a danger of torsional oscillations being induced. Distance pieces which are located between the blades and extend over the whole width of the blade row, such as have also already been proposed, serve in the first place to damp bending vibrations and can also damp torsional oscillations on condition that they are stiff enough and are accurately dimensioned. A disadvantage is that they disturb the flow of the driving medium too much. The distance pins according to the invention can, however, easily be located in the right position and adjusted to the correct length and prevent effectively the occurrence of torsional oscillations in the blades; furthermore they can readily be shaped in such a way that they offer only very slight resistance to the flow of the driving medium.

What we claim is:—

1. Vibration damper for the blades of elastic fluid turbines, compressors and the like, characterised by distance pins arranged approximately perpendicularly to the blade chords between all the blades of a blade row, the pins being fixed at one end only to a blade whilst at the other end they abut freely against pins fixed to the next blades or directly against the next blades, in the vicinity of at least one edge in order to damp torsional vibrations of the blades.

2. Vibrations dampers substantially as herein described with reference to the accompanying diagrammatic drawings.

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1 SHEET

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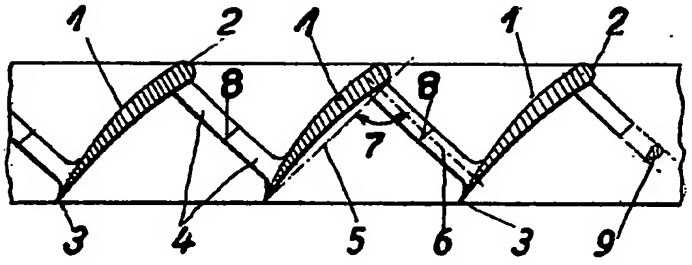

Fig.1

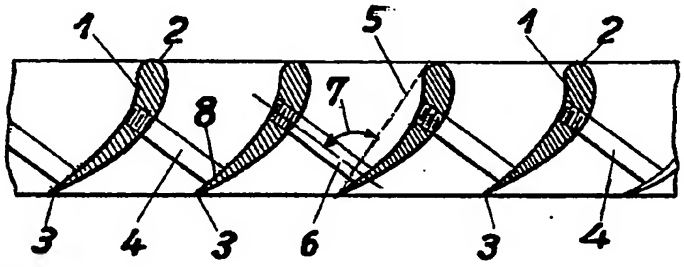

Fig.2

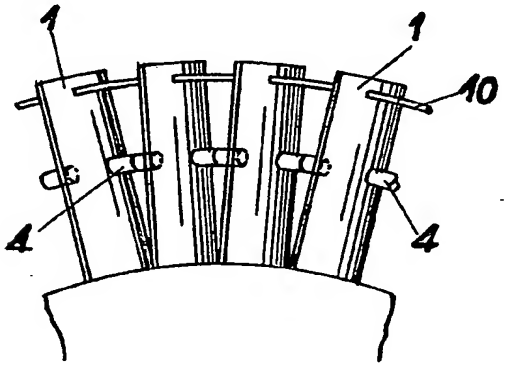

Fig.3